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Information Technology Infrastructure as a Moderator of Organization's IT Productivity: An Economic Perspective

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Abstract

This study employs the concept of IT infrastructure to consider the inside of black box used in input-oriented IT productivity studies. This study differentiates IT infrastructure from other ITs that perform business functions directly. IT infrastructure has great contribution on IT productivity by supporting the appropriate use of other ITs (applications). Thus it is argued that in measuring IT productivity, the contribution of IT infrastructure investment should be considered separately within the measured IT investment (i.e. total IT spending).

Introduction

Justifying IT investment has been a critical issue in the IS area. Several studies have tried to justify an organization's IT spending using financial data. In the economic perspective, using economic theory IT is treated as one of inputs like capital and labor, in a production function (cf. Brynjolfsson and Hitt, 1996). The general research question considers how IT spending is related to productivity. Due to its higher productivity, economic theorists think of IT as a better input of production than ordinary capital and labor (Brynjolfsson and Hitt, 1995) or substitute other inputs (traditional capital and labor) in the production of goods and services (Dewan and Min, 1997).

From an economic perspective, an organization is viewed as a production function, as black box. In other words, organizations can achieve the same IT performance when they invest in the same IT. In fact, with the same IT, organizations produce different IT performance. We need open up this IT performance black box. Dewan and Min (1997) mentioned the black box as an unanswered question in the IT productivity studies. Weill and Olson (1989) explained it as IT conversion effectiveness, the ability of an organization to transform its IT spending into economic and social value. Behavioral studies in IT investment have identified the factors that constitute such organization's abilities by looking at the how well IT are used, diffused, and implemented.

There are also some such studies employing economic perspectives. Using transaction cost theory, Shin (1997), for example, found that since IT reduces coordination cost and improves coordination within and across organizations, IT contributes to productivity. Brynjolfsson and Yang (1997) considered the contribution of unmeasured, intangible assets that are overlooked in production function model. These intangible assets are organizational routines, relationships and human capital that are associated with the measured IT investments.

This paper contends that computation of IT productivity, without considering the different role of IT within measured total IT investments, may mislead researchers in their search for the real contribution of IT investment to productivity. This paper considers an organization's IT infrastructure to have a role different from other ITs in explaining the relationship between IT investment and firm output.

What Is IT Infrastructure?

IT infrastructure is defined as a set of technological components, services, and expertise that are shared within and across organizations (Broadbent and Weill, 1997). IT infrastructure become a foundation to enable present and future business applications (Keen, 1991) and upon which organizational systems and processes are built (Ross, 1997). The role of IT infrastructure is better conceptualized as proving capabilities, such as facilitating intraorganizational communications, providing ready access to data, integrating business processes, and establishing customer linkages (Ross, 1997). The purpose of building IT infrastructure is to support commonality between different applications and uses facilitating information sharing across the organization and cross-functional integration and to obtain economies of scale (Broadbent, et al., 1996). IT infrastructure is compromised of two elements: technical IT infrastructure and human IT infrastructure (McKay and Broakway, 1989; Keen, 1991). Technical IT infrastructure consists of platform technology (hardware and operating systems), general purpose databases, productivity tools such as CASE, and network and telecommunication technologies that are commodities and readily available in the marketplace. Human IT infrastructure includes human knowledge, skills, and experience relative to IT. The human IT infrastructure includes both technical expertise and managerial expertise (Weill, 1993). The technical expertise relates to the operation and integration of the IT components. The managerial expertise includes the IT planning process, scanning for new technology, budgeting and managing the interaction with other groups in the firm. The human infrastructure binds IT components

into a reliable set of shared IT infrastructure services. The ability of IT infrastructure to provide such services determines an organization's IT infrastructure capabilities, which have greater impact upon its IT performance.

Current thought differentiates IT infrastructure from other ITs (applications). Applications are better regarded as the use of the IT resources or embodiment of IT resources in new product, new process, or improved coordination and control, than as the resources themselves. By contrast, IT infrastructure is considered as the tangible IT resources themselves, along with the people and procedures required to manage them (Markus and Soh, 1993). Grossman and Packer (1989) provide different aspects. First, the purpose of the applications is to deliver business functionality, while the purpose of IT infrastructure is to provide a platform for business applications. Second, the scope of a application is narrower, usually supporting one business process, product, or function (e.g. managing inventory). The scope of IT infrastructure is much broader, crossing most functions and products (e.g. network and database services for business units). In addition, IT infrastructure represents centralized IT investments, and is delivered at agreed service levels for a negotiated price to the business units or functional areas.

The precise business benefits of the IT infrastructure are difficult to measure. The value of IT infrastructure is derived from the business applications connected to, and enabled by, the infrastructure. Additionally, IT infrastructure provides and determines flexibility in meeting marketplace needs (Keen, 1991). Generally, it is reasonable to expect IT infrastructure will improve productivity, leverage user groups' own IT investment, and enable rapid response to new business needs.

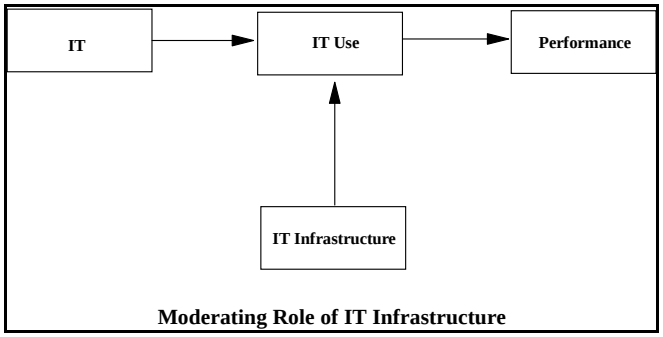
The Impact of IT Infrastructure on IT Productivity

According to resource-based view of competitive advantage, an organization's performance is determined by its superior and inimitable resources (Barney, 1992). IT infrastructure is potentially such a resource, and is also complementary to other IT resources, in that it improves organizational IT performance through leveraging other IT resources.

Moderating Role of IT infrastructure

In general, IT infrastructure can be viewed as tangible IT environment that governs the organization's IT activities. IT environment may include the organization's IT strategy, IT policy, IT knowhow, IT structure, etc.. It governs how IT is properly used, implemented, diffused, etc., and thereby determines the organization's IT performance. Therefore, the IT infrastructure plays a complementary role in the organization's IT activities. Especially, the high quality of IT infrastructure can provide better use and thus better performance of other ITs that perform business functions directly. Corporate database, for example, provide data necessary to decision support systems or expert systems. Corporate network technologies provide Internet connection service. With proper reach and range, IT infrastructure will have great contribution to the IT performance. Without ample IT connectivity and bandwidth, business applications (e.g. EDI) will not provide expected performance. In addition, a high quality of IT infrastructure provides conditions conducive to successful IT innovation and implementation that assumed better and appropriate use of organization's IT. Once IT is successfully diffused and implemented in an organization, it can be used and expanded to optimize interorganizational, organizational and individual tasks, and thereby improve performance. In this view, an organization's IT infrastructure enables or inhibits appropriate IT use by shaping an organization's IT environment.

As such, the role of IT infrastructure in an organization can be considered as a moderator that enables appropriate IT use in the organization, as described in the following model.



Moderating Role of IT Infrastructure

Alternative Measure of IT Productivity

Measuring the IT infrastructure spending is difficult, as its definition differs among organizations and/or business units. In other words, some organizations consider the IT to be applications, while others consider it infrastructure, depending upon its role in the organization's work. Network technologies, for example, may be considered an application for communications firms that provide network services to other organizations, since theses ITs are performing their business functions directly. In contrast, these ITs are the infrastructure for other firms. Likewise, within a firm, business units think of the same IT differently. Measuring IT infrastructure's productivity contribution also proves difficult, since it does not directly impact productivity, but instead interacts with business applications that directly impact productivity. However, by considering the moderating roles of IT infrastructure, the alternative measure of IT productivity will be:

IT productivity = f (IT infrastructure spending, other IT spending)

In the above function, IT infrastructure can be measured as central IT investment based on the corporate IT strategy (Broadbent and Weill, 1997). This investment is usually made to develop, implement, and maintain firm-wide IT that spans several business units and supports their IT. These activities are performed by the central corporate IS department. Thus, we can use a central IS department spending as a surrogate for its IT infrastructure spending.

Conclusion

This study employs the concept of IT infrastructure to consider the inside of black box used in input-oriented IT productivity studies. It will help researchers and practitioners in the IT value research by providing the needs of dividing an organization's total IT spending into IT spending doing direct and indirect business functions.

The study is limited in its measurement of IT infrastructure and its fine tuning of the definition of IT infrastructure in general. Spending for central IS department is not a sufficient measurement for IT infrastructure. Thus, future research may need to build more adequate definition of IT infrastructure, one that can be applicable to most organizations and business units. Future research may also focus on measuring IT infrastructure investment more thoroughly and on empirically testing the productivity function suggested in this study.

References

References available upon request from the author (choi1007@siu.edu).